Integrating of Cyberinfrastructures to Provide Hydrologic Data for the Restoration of the Everglades

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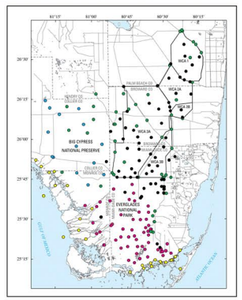
The Everglades Depth Estimation Network (EDEN) is an integrated network of real-time water-level monitoring, ground-elevation modeling, and water-surface modeling that provides scientists and managers with current (1999-present), on-line water-depth information for the entire freshwater portion of the Greater Everglades. Presented on a 400-square-meter grid spacing, EDEN offers a consistent and documented dataset that can be used by scientists and managers to: (1) integrate hydrologic networks, (2) guide large-scale field operations, and (3) support biological and ecological assessments of the Everglades.

Monitoring Network

The EDEN water-level network (fig. 1) of 300 monitoring stations is operated by Big Cypress National Preserve (BCNP), Everglades National Park (ENP), South Florida Water Management District (SFWMD), and the U.S. Geological Survey (USGS). Data include hourly surface-water and groundwater measurements to the North American Datum of 1988 (NAVD 88).

Data from water-level gages are transmitted via radio or satellite telemetry to the operating agency's data servers. Data from BCNP, ENP, and SFWMD are then transferred to the USGS and entered into the USGS National Water Information System (NWIS) database. Once in NWIS, the data are available through the EDEN website (http://sofia.usgs.gov/eden) where the data can be accessed as graphs, tables, or downloadable files.



Gage location and Operating Agency:
- Big Cypress National Preserve
- Everglades National Park
- South Florida Water Management District
- U.S. Geological Survey (freshwater nontidal)
- U.S. Geological Survey (tidal)

Figure 1. Map showing the location of the EDEN gages.

Ground-Elevation Model

Ground-surface elevation data were collected by the USGS at more than 50,000 points for each 400-meter cell of the EDEN grid (fig. 2). These data were used to develop the digital elevation model (DEM) of the ground (Jones, J.W. and Price, S.D., 2007) and is the foundation for all the EDEN water depth and EDEN analysis tools. The spatial parameters of the cells within the grid include the location of centroid, the elevation, and percentage of vegetation type.

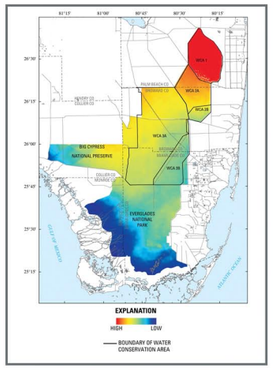


Figure 2. The digital ground-elevation model for EDEN.

Spatially continuous interpolation of water surface across the greater Everglades is generated for daily values of the water-level gages for the EDEN network. Data are exported from the USGS NWIS server on to an ftp server where it is collected, modeled into daily water surfaces, and then exported into NetCDF and GeoTiff formats, which allows retrieval of geo-coded time-series data and import into ArcGIS.

Water-Surface Model

A water-surface model was developed in a Geographic Information System (GIS) using the EDEN grid (Palaseanu, M. and Pearlstine, L., 2008). The model interpolates measured water levels from the EDEN continuous monitoring network to ungaged locations using a radial-basis function and produces a continuous water-surface elevation map for any day within the period of record of the EDEN database (fig. 3).

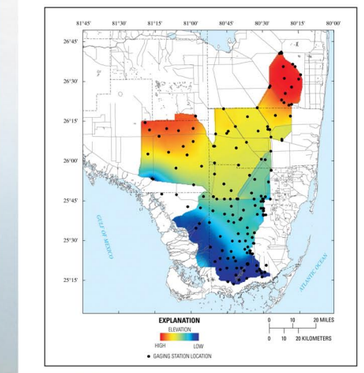
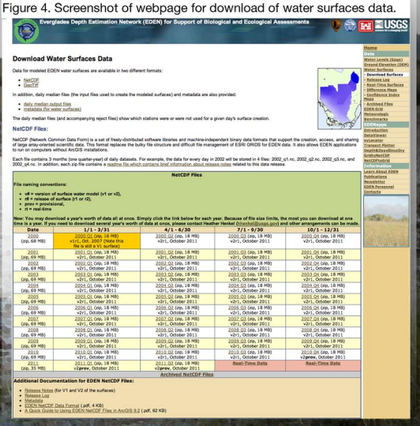


Figure 3. Example water-surface elevation map.

Figure 4. Screenshot of webpage for download of water surfaces data.



EDEN website (http://sofia.usgs.gov/eden)

Internet Dissemination of EDEN Information

The information from EDEN is available to scientists, engineers, and water-resource managers through a webpage that integrates the real-time monitoring data and GIS model results (http://sofia.usgs.gov/eden). The purpose of the website is to integrate EDEN monitoring and modeling data and provide "one-stop shopping" for data with a consistent data format and documentation. The EDEN website is accessed through an interactive map showing the location of gaging stations in the network, and provides "clickable" access to gage data on a near real-time basis

In addition to the real-time gage information (such as such as station descriptions, measured ground elevation, and vegetation in the vicinity of the gaging station), the EDEN website serves the daily water surfaces (fig. 4). The data are served as both quarterly data sets from January 2000 - December 2007 as well as real-time water surfaces. To enable access to EDEN data, a suite of tools have been created which allow users to view, export, and manipulate data.

EDEN Depth&DaysSinceDry (fig. 5A) is a program for creating daily surfaces (in NetCDF file format, .nc) of water depth and days since dry from EDEN daily water-level surfaces and ground-elevation model.

EDEN Data Viewer (fig. 5B) displays EDEN data layers including panning, zooming, and animation of multiple dates of water surface, depth, and days since dry; queries of data values, and generation of time-series graphs.

EDEN Transect Plotter (fig. 5C) allows users to select a point-to-point transect (not necessarily a straight line) and plots EDEN data profile over the time series, includes animation, plotting of observer data, and ground slope.

EDEN xyLocator (fig. 5D) is a program for extracting data from spatial hydrology time-series. Data are extracted for specific x,y positions over the time range supplied by the user. The user also can choose among outputs for water stage, water depth, ground elevation (DEM), and days since dry.

In addition to these four EDEN tools, two utilities that allow users to convert between ESRI grid files and NetCDF files (EDEN **GridtoNetCDF** and **NetCDFtoGrid)** are provided.

Figure 5A.

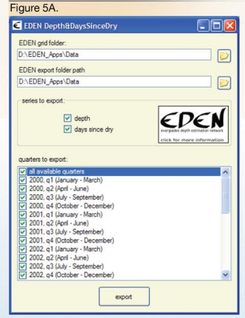


Figure 5B.

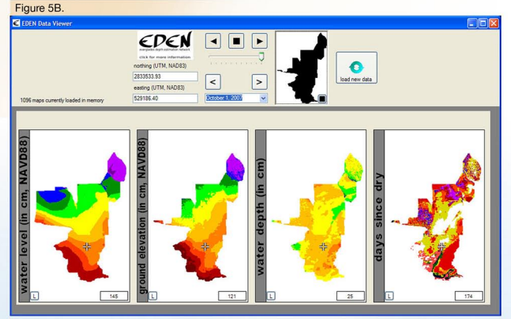


Figure 5C.

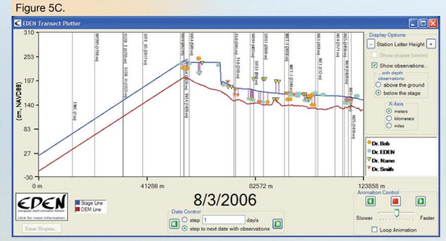


Figure 5D.

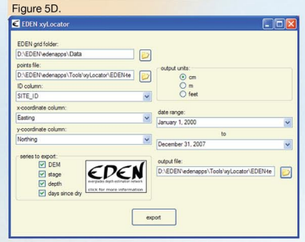


Figure 5. Screen shots of EDEN utilities for extracting data: A) Depths and days since dry; B) Data viewer; C) Transect Plotter; and D) xy locator.

Gage W11 in Water Conservation Area 3A.

References:

Jones, John W. and Price, Susan D., 2007, Initial Everglades Depth Estimation Network (EDEN) digital elevation model research and development: U.S. Geological Survey Open-File Report 2007-1034, 29 p.

Palaseanu, M., Pearlstine, L., 2008, Estimation of water surface elevations for the Everglades, Florida. Computers and Geosciences, doi:10.1016/j.cageo.2007.08.004.